

CPC High-Resolution Global Precipitation Analyses Suite for Improved Monitoring, Assessments and Diagnostics of Global Climate

*Pingping Xie,
Robert Joyce, Shaorong Wu, and Fengying Sun*

NOAA Climate Prediction Center

2013.10.21.

Objectives

- Introducing the CPC high-resolution global precipitation analyses
- Illustrate their applications in climate analysis and climate model / reanalysis verifications

Components of the CPC Hi-Res Precipitation Analyses

- CMORPH integrated satellite precipitation estimates
- Bias-corrected CMORPH
- Blended daily analyses of CMORPH and gauge observations

CMORPH Satellite Precipitation Estimates

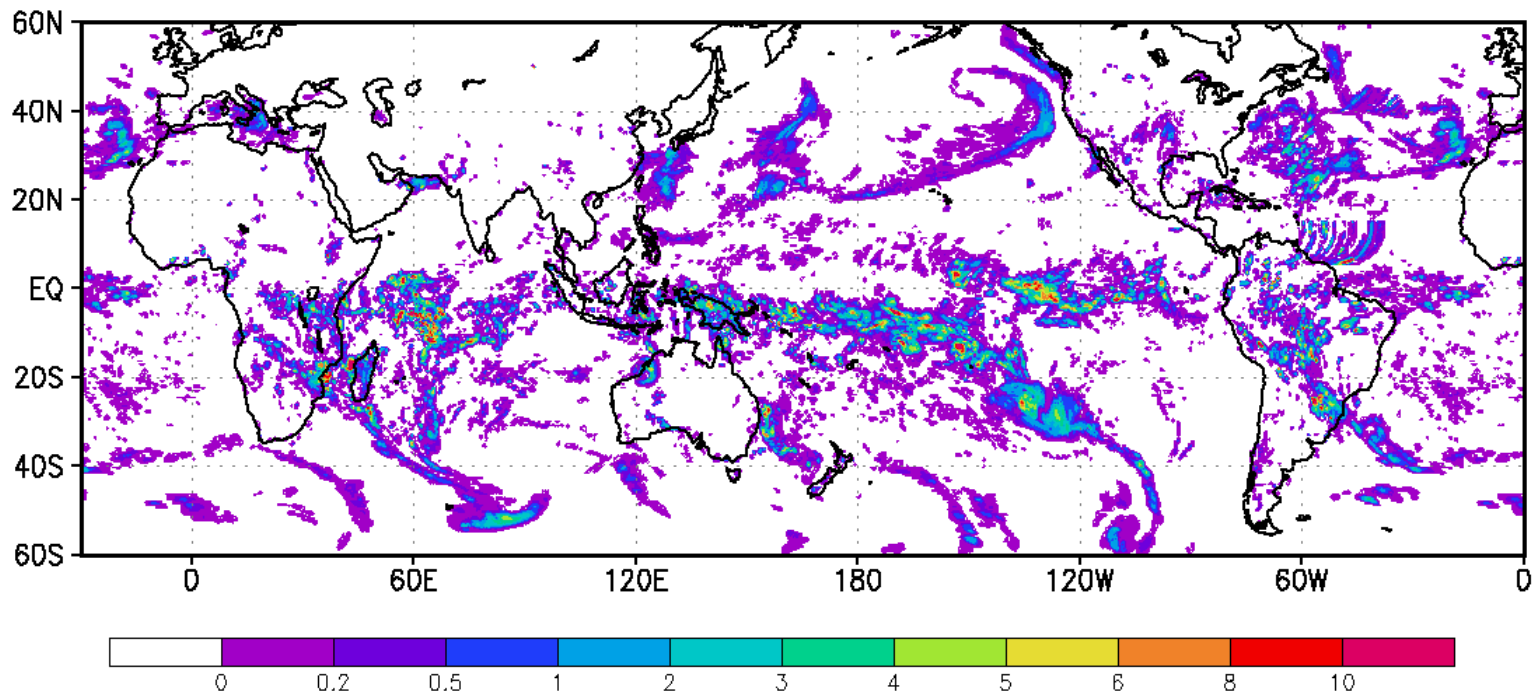
1) Overview

- Defined by integrating information from both the passive microwave and infrared observations from multiple satellites
 - *Joyce et al. (2004); Joyce and Xie (2011)*
 - *Cloud motion vectors derived from consecutive IR images from geostationary satellites*
 - *Retrievals of instantaneous precipitation fields detected by low earth orbit satellites propagated from observation times to target analysis time*
- Reprocessing completed
 - *8kmx8km over the globe (60°S-60°N)*
 - *30-min interval from 1998 to the present*

CMORPH Satellite Precipitation Estimates

2) Sample Animation

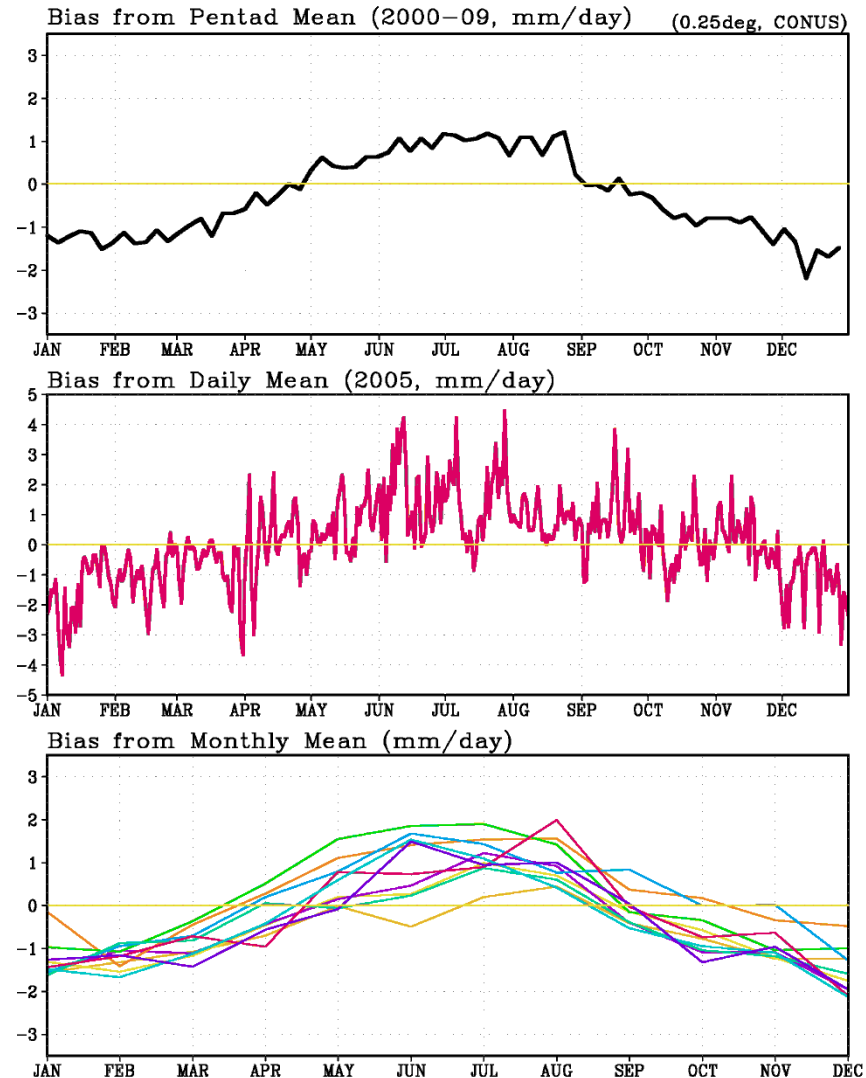
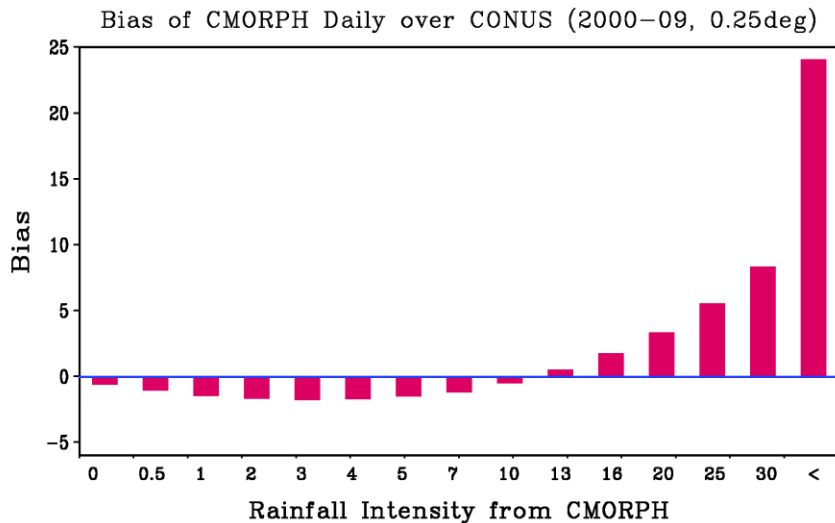
CMORPH 3hourly Precip for 1998. 2. 1. 0Z



CMORPH Bias Correction

1) Bias in the raw CMORPH

Regionally different
Temporally changing
Non-linear



CMORPH Bias Correction

2) Strategy

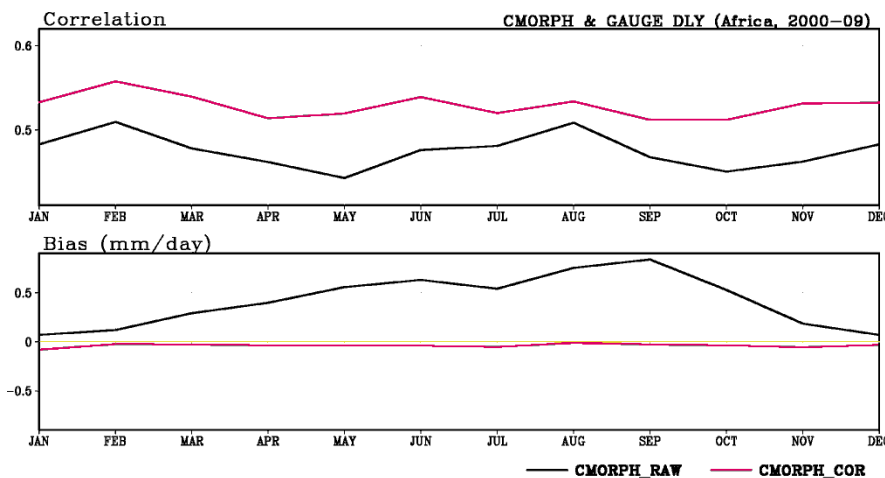
- Over Land
 - PDF matching against daily gauge analysis
 - PDF tables established as a function of region and season using historical and real-time data
- Over Ocean
 - Calibration against a long-term record (pentad GPCP) with stable quality but coarser resolution (2.5°lat/lon, 5-day)

CMORPH Bias Correction

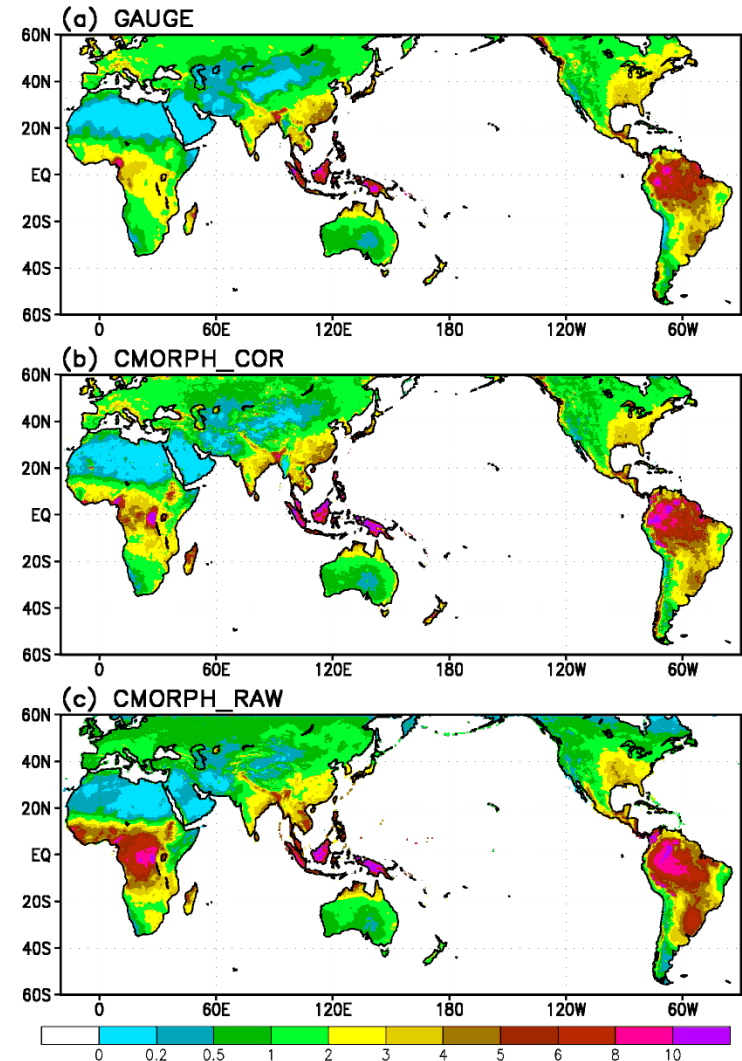
1) Results over land

- Large-scale bias removed
- Correlation improved

Comparison over Africa



2000-2009 Annual Mean



CMORPH Bias Correction

1) Comparison with daily gauge for June 2011

Correlation

Region	CPC Original	CPC HS CRTD	CPC RT CRTD
Globe	0.551	0.617	0.647
60N-40N	0.535	0.549	0.587
40N-20N	0.578	0.650	0.677
20N-20S	0.553	0.584	0.602
20S-40S	0.605	0.715	0.767
40S-60S	0.666	0.684	0.698

Bias

CPC Original	CPC HS CRTD	CPC RT CRTD
0.098	-0.247	-0.171
0.003	-0.481	-0.142
0.848	0.177	-0.135
-0.512	-0.540	-0.261
-1.128	-0.477	-0.256
-2.755	-0.921	-0.467

- Bias in mm/day
- Bias reduced substantially in CPC version of the estimates

Combining Bias-Crtd CMORPH with Gauge

1) Strategy

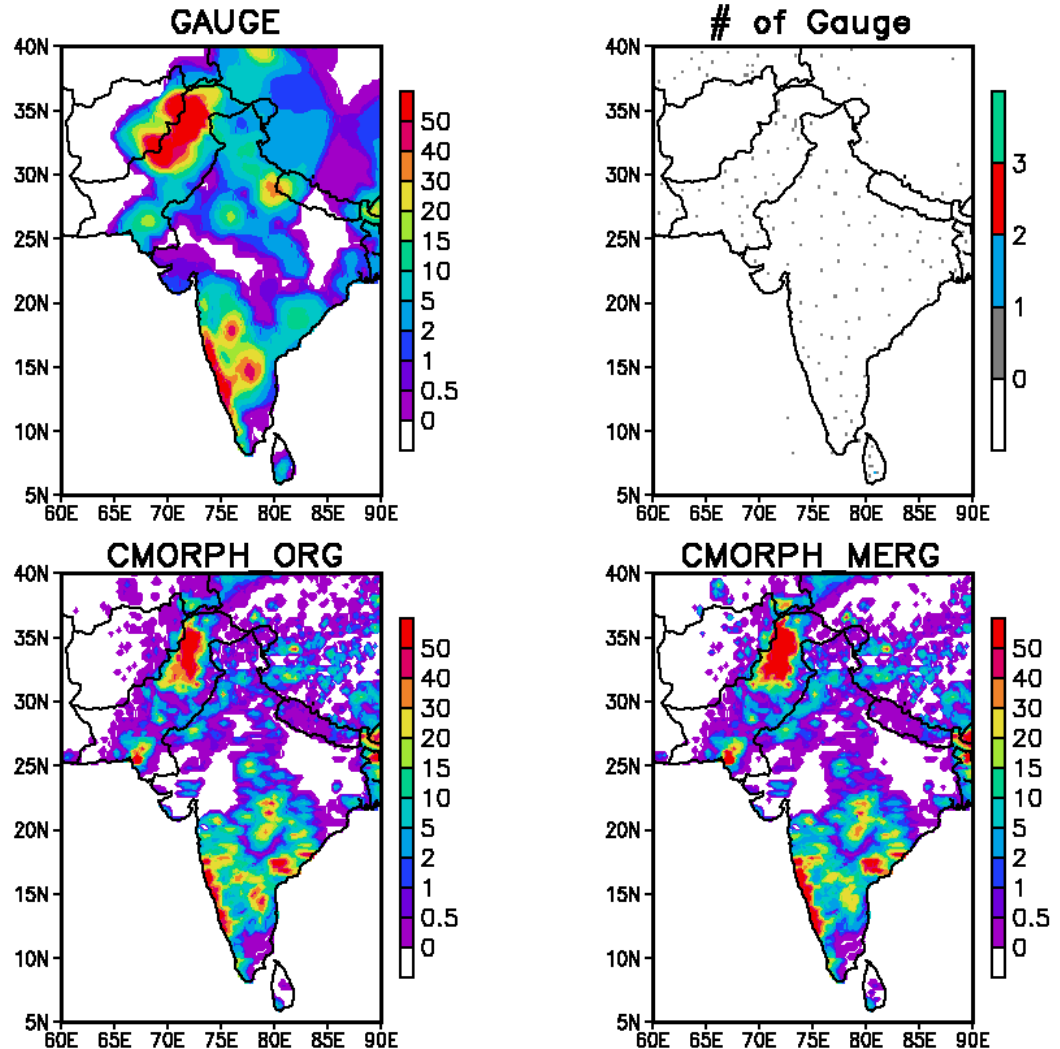
- This is only possible for several regions due to different daily ending time in the gauge reports
 - Africa (06Z)
 - CONUS/MEX (12Z)
 - S. America (12Z)
 - Australia (00Z)
 - China (00Z)
- Based on Xie and Xiong (2011)
Combining the bias-corrected CMORPH with gauge observations through the Optimal Interpolation (OI) over selected regions where gauge observations have the same daily ending time
 - *CMORPH and gauge data are used as the first guess and observations, respectively*

Combining Bias-Crtd CMORPH with Gauge

2. Example

- Gauge analysis depict heavy rain but tend to extend the raining area
- Satellite data tend to under-estimate
- Merged analysis present improved depiction of the heavy rain

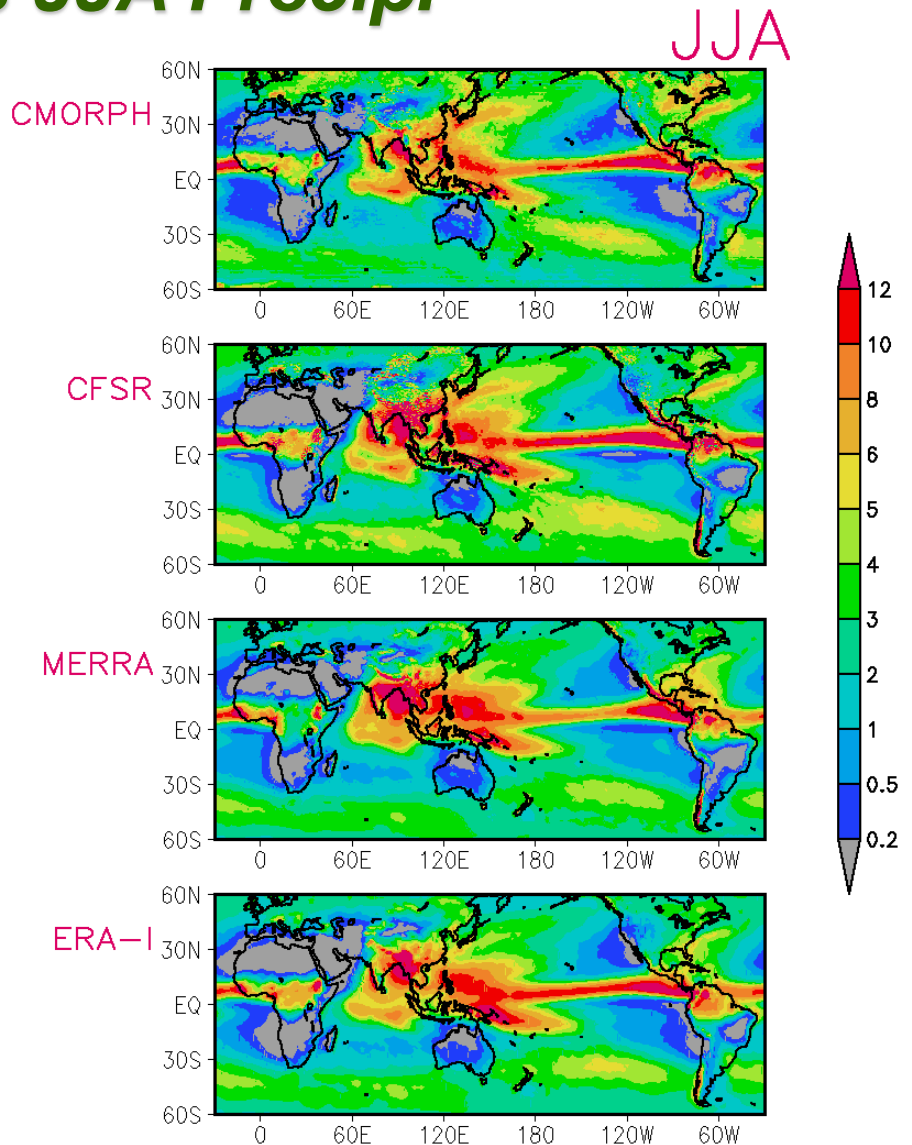
Dalily Precip [mm/day] July 28 2010



Applications [1]

Evaluation of Reanalyses JJA Precip.

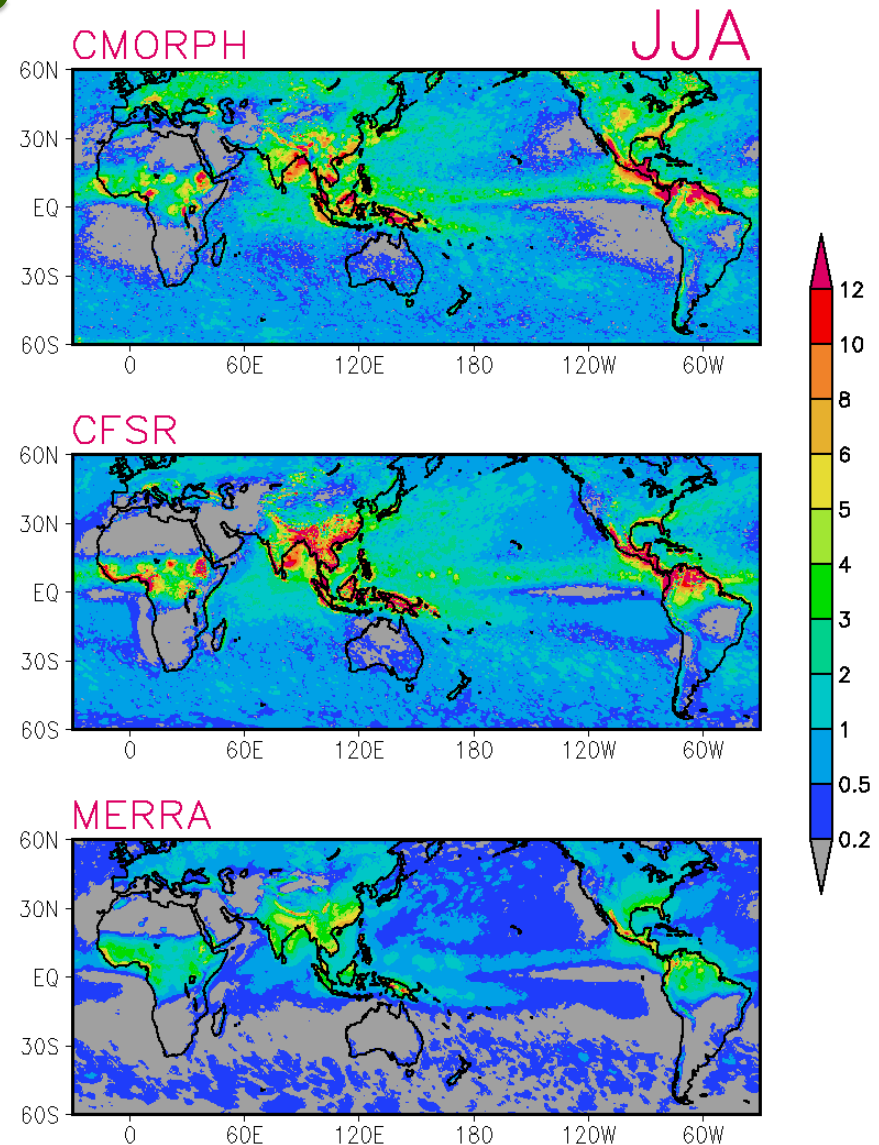
- JJA Mean for 1998 – 2010
- Spatial pattern of precipitation, especially that associated with topography, well reproduced by the reanalyses
- Larger oceanic precipitation in CFSR and ERA-I
- Weaker precipitation over mid-latitude compared to the CMORPH
- Heavier rainfall over Maritime-continent



Applications [2]

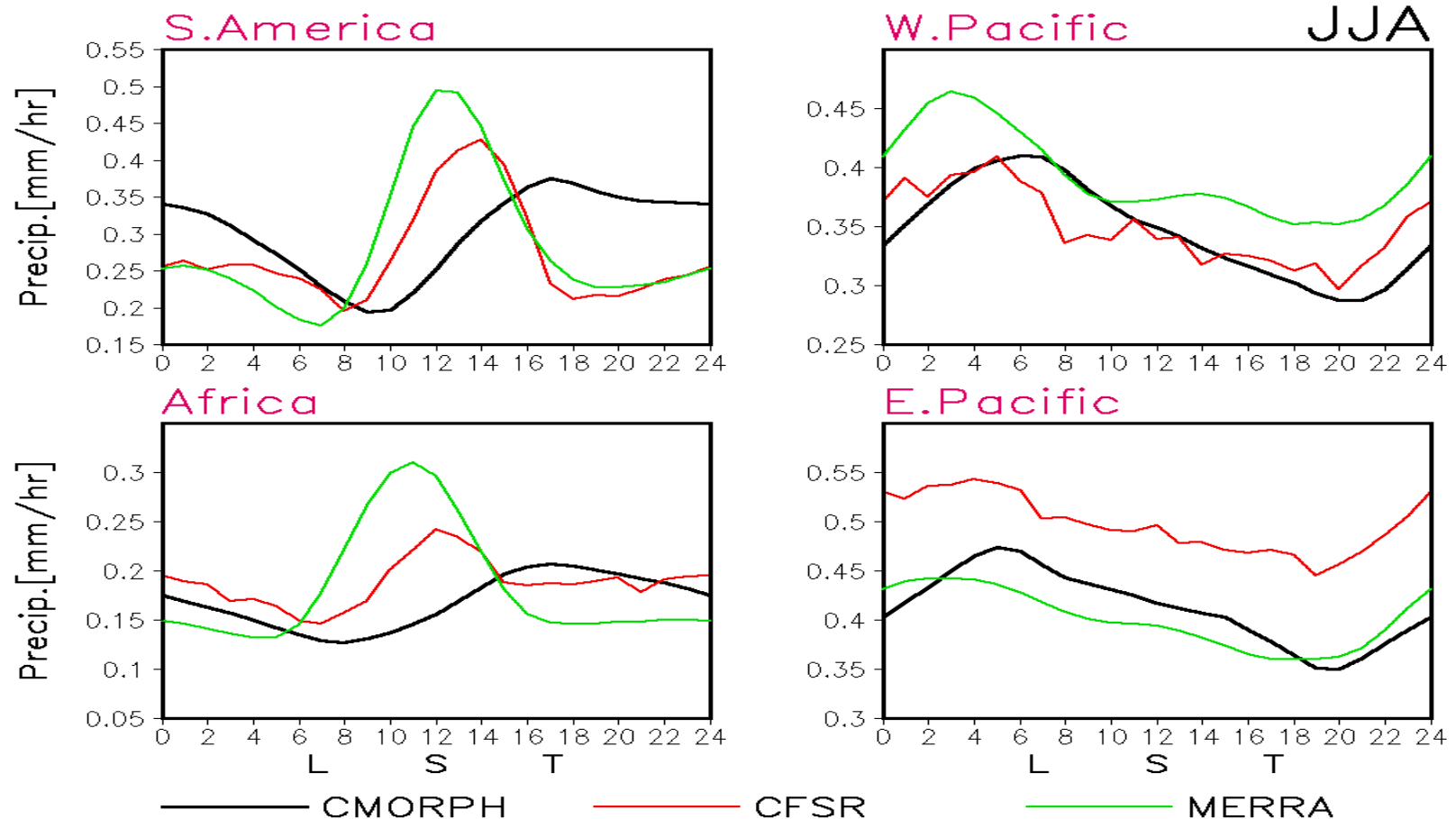
Precipitation Diurnal Cycle

- Standard deviation of 24 hourly means for 1998-2010 (mm/day)
- Diurnal amplitude in CFSR is very similar to that in the observations but presents smaller / larger over ocean, extra-tropical land / tropical land
- Diurnal amplitude in MERRA is generally smaller than that in the observations over tropics and extra-tropics in northern hemisphere and is almost diminished over extra-tropics in southern hemisphere



Applications [3]

Diurnal Cycle over Four Selected Regions

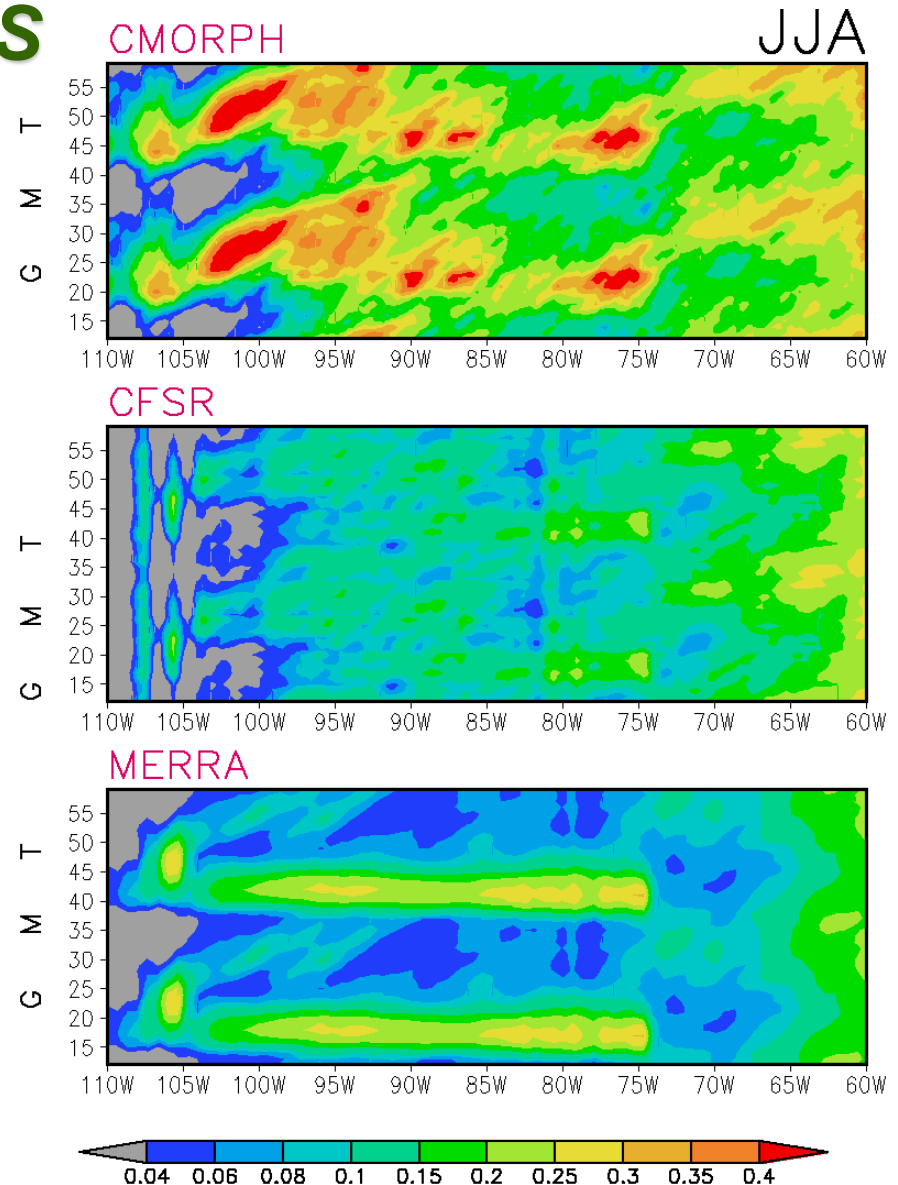


- Peak in the reanalyses comes earlier
- Amplitude in the reanalyses is larger / smaller over tropical land / ocean

Applications [4]

Diurnal Cycle over CONUS

- Longitude section (X-axis) of diurnal evolution (Y-axis) along 40°N over CONUS
- Diurnal cycle (Y-axis) repeated twice
- Precipitation starts from the eastern Rocky around early afternoon (20GMT), traveling eastward and reaching 90°W late afternoon the next day
- Diurnal cycle over land east of 90°W presents fixed phase, opposite to that of precipitation over nearby ocean
- Neither CFSR nor MERRA captures this diurnal variation patterns very well



Summary

- Three sets of gauge-satellite precipitation analyses
 - *Reprocessed CMORPH Satellite Estimates*
 - *Bias-corrected Satellite Estimates*
 - *Gauge-satellite combined analyses*
- Data sets are being released at:
<ftp.cpc.ncep.noaa.gov/precip>
- The CPC high-resolution global precipitation analysis improves our capability to monitor, analysis and assess global precipitation
- Your comments highly appreciated
- POC:

Pingping.Xie@noaa.gov